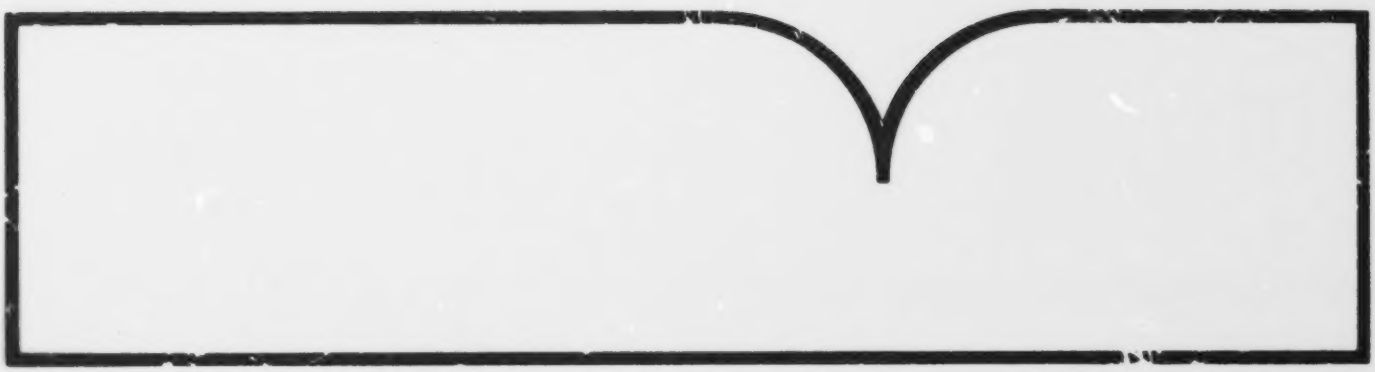
PB90-166505

Proposed Best Demonstrated Available Technology (BDAT) Background Document for Stripping Still Tails from the Production of Methyl Ethyl Pyridine K026. Volume 12

(U.S.) Environmental Protection Agency, Washington, DC

Nov 89



U.S. Department of Commerce
National Technical Information Service
NTIS

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/530-SW-90-012L	2.	3. PB90-166505
4. Title and Subtitle PROPOSED BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR K026 (STRIPPING STILL TAILS FROM THE PRODUCTION OF METHYL ETHYL PRYIDINE)			5. Report Date NOVEMBER 1989 6.
7. Author(s) BERLOW/LABIOSA/OSW			8. Performing Organization Rept. No
9. Performing Organization Name and Address U.S. EPA Office of Solid Waste 401 M. Street SW Washington, DC 20460			10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered BACKGROUND DOCU. - 11/89 14.
15. Supplementary Notes			

16. Abstract (Limit: 200 words)

This background document provides the Agency's rationale and technical support for selecting the constituents for proposed reugaltion in K026 and for developing treatment stadards for hese constiuents. The document also provides waste characterization data that serve as a basis for determining whether a variance from a treatment standard may be warranted for a particular type of K026 that is more difficult to treat than the wastes that were analyzed in developing treatment standards for K026.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
RELEASE UNLIMITED	UNCLASSIFIED	0
	20. Security Class (This Page) UNCLASSIFIED	22. Price 0

(See ANSI-Z39.18)

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)

EPA/530-SW-90-012L

PROPOSED

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

BACKGROUND DOCUMENT

FOR STRIPPING STILL TAILS FROM THE PRODUCTION OF METHYL ETHYL PYRIDINE

K026

James R. Berlow
Chief, Waste Treatment Branch

Jose Labiosa
Project Manager

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Solid Waste
401 M Street, S.W.
Washington, D.C. 20460

November 1989

Note: This proposed Background Document is being issued in support of the Agency's proposed rulemaking for the land disposal restrictions program. The Agency solicits comments on the proposed rule and on this proposed Background Document. This document will be issued in final form, appropriately revised in response to comments, at the time of promulgation of the final rule.

TABLE OF CONTENTS

Section		Page
1.0	INTRODUCTION	1-1
2.0	INDUSTRY AFFECTED AND WASTE CHARACTERIZATION	2-1
	2.1 Industry Affected and Process Description	2-1
	2.2 Waste Characterization	2-2
3.0	APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES	3-1
	3.1 Applicable Treatment Technologies	3-1
	3.2 Demonstrated Treatment Technologies	3-5
4.0	TREATMENT PERFORMANCE DATA BASE	4-1
5.0	IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)	5-1
6.0	SELECTION OF CONSTITUENTS PROPOSED FOR REGULATION	6-1
7.0	CALCULATIONS OF PROPOSED BDAT TREATMENT STANDARDS	7-1
	7.1 Calculation of Proposed Treatment Standards for K026 Nonwastewaters	7-3
	7.2 Calculation of Proposed Treatment Standards for K026 Wastewaters	7-4
8.0	ACKNOWLEDGEMENTS	8-1
9.0	REFERENCES	9-1
	APPENDIX A - ACCURACY CORRECTION OF TREATMENT PERFORMANCE DATA	A-1

LIST OF TABLES

Table	Title	Page
1-1	PROPOSED BDAT TREATMENT STANDARDS FOR K026 NONWASTEWATERS ..	1-5
1-2	PROPOSED BDAT TREATMENT STANDARDS FOR K026 WASTEWATERS	1-6
2-1	K026 CHARACTERIZATION DATA	2-4
4-1	WASTES TESTED BY INCINERATION AND SAMPLED BY EPA	4-4
4-2	WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019 AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION	4-5
4-3	TREATMENT PERFORMANCE DATA COLLECTED BY EPA FOR K019 AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION KILN ASH RESIDUAL	4-9
4-4	TREATMENT PERFORMANCE DATA COLLECTED BY EPA FOR K019 AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION - SCRUBBER WATER RESIDUAL	4-10
4-5	DESIGN AND OPERATING DATA FOR THE ROTARY KILN AND SECONDARY COMBUSTOR	4-11
7-1	CALCULATION OF TREATMENT STANDARDS FOR CONSTITUENTS PROPOSED FOR REGULATION IN K026 NONWASTEWATERS AND WASTEWATERS	7-7
A-1	MATRIX SPIKE RECOVERIES FOR KILN ASH RESIDUAL	A-5
A-2	MATRIX SPIKE RECOVERIES FOR SCRUBBER WATER RESIDUAL	A-6
A-3	ACCURACY-CORRECTED DATA USED TO CALCULATE TREATMENT STANDARDS FOR CONSTITUENTS PROPOSED FOR REGULATION IN K026	A-7

LIST OF FIGURES

Figure	Title	Page
2-1	FLOW DIAGRAM FOR THE PRODUCTION OF METHYL ETHYL PYRIDINE (MEP)	2-3

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA or Agency) is proposing to establish best demonstrated available technology (BDAT) treatment standards for the listed hazardous waste identified in Title 40, Code of Federal Regulations, Section 261.32 (40 CFR 261.32) as K026, stripping still tails from the production of methyl ethyl pyridine. These BDAT treatment standards are being established in accordance with the amendments to the Resource Conservation and Recovery Act (RCRA) of 1976, enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984. BDAT treatment standards will be effective no later than May 8, 1990, and on or after the effective date, compliance with these BDAT treatment standards will be a prerequisite under 40 CFR Part 268 for placement of the waste in land disposal units.

This background document provides the Agency's rationale and technical support for selecting the constituents for proposed regulation in K026 and for developing treatment standards for these constituents. The document also provides waste characterization data that serve as a basis for determining whether a variance from a treatment standard may be warranted for a particular type of K026 that is more difficult to treat than the wastes that were analyzed in developing treatment standards for K026.

The Agency's legal authority and promulgated methodology for establishing treatment standards and the petition process necessary for requesting

a variance from the treatment standards are summarized in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1).

This background document presents waste-specific information on the number and locations of facilities that may be affected by the land disposal restrictions for K026, the processes generating this waste, the waste characterization data, the technologies used to treat the waste (or similar wastes, if any), and the treatment performance data on which the proposed treatment standards are based (Sections 2.0 - 4.0). This document also explains how EPA determines BDAT, selects constituents to be regulated, and calculates treatment standards (Sections 5.0 - 7.0).

Under 40 CFR 261.32, wastes identified as K026 are listed as follows:

K026 - Stripping still tails from the production of methyl ethyl pyridine.

The four-digit Standard Industrial Classification (SIC) code associated with the production of methyl ethyl pyridine is 2869. The Agency is not aware of any domestic facilities that generate K026.

The Agency is proposing one organic constituent for regulation in nonwastewater and wastewater forms of K026. To determine the applicability of the treatment standards, wastewaters are defined as wastes containing less

than 1% (weight basis) total suspended solids[1] (TSS) and less than 1% (weight basis) total organic carbon (TOC). Wastes not meeting this definition are classified as nonwastewaters and must comply with nonwastewater treatment standards.

The Agency does not have any performance data on the treatment of K026. Treatment performance tests for this waste have not been pursued because the Agency believes that adequate treatment performance data are available from similar wastes previously tested by the BDAT Land Disposal Restrictions Program. Therefore, treatment performance data were transferred to K026 from another previously tested waste.

For nonwastewater and wastewater forms of K026, proposed BDAT treatment standards are based on treatment performance data transferred from incineration of the RCRA Blend waste that was co-treated with K019.

Tables 1-1 and 1-2 at the end of this section list the proposed BDAT treatment standards for nonwastewater and wastewater forms of K026. These proposed treatment standards are based on the total concentration of pyridine in the waste. The units used for total constituent concentration are mg/kg

---

[1]The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids". Specifically, total suspended solids is measured by Method 209C (total suspended solids dried at 103-105°C) in Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition (Reference 2).

(parts per million on a weight-by-weight basis) for K026 nonwastewaters, and mg/l (parts per million on a weight-by-volume basis) for K026 wastewaters. If the concentrations of the constituent proposed for regulation in K026 nonwastewaters and wastewaters, as generated, is lower than or equal to the proposed treatment standards, then treatment of the waste would not be required prior to "land disposal," as defined by 40 CFR Part 268.

EPA is also proposing to establish a method of treatment as the treatment standard for nonwastewater and wastewater forms of K026 as an alternative to specifying numerical treatment standards. The Agency is proposing this alternate treatment standard because it is uncertain whether other constituents, which may not be controlled for by regulation of the BDAT List constituent proposed for regulation, are present in K026, due to a lack of characterization data for K026. These alternative treatment standards are shown in Tables 1-1 and 1-2, for nonwastewater and wastewater forms of K026, respectively.

Table 1-1

PROPOSED BDAT TREATMENT STANDARDS FOR K026

NONWASTEWATERS

Maximum for Any Single Grab Sample	
BDAT List Constituent	Total Concentration (mg/kg)
39. Pyridine	14

OR

INCINERATION AS A METHOD OF TREATMENT

Table 1-2

PROPOSED BDAT TREATMENT STANDARDS FOR K026

WASTEWATERS

Maximum for Any Single Grab Sample	
BDAT List Constituent	Total Concentration (mg/L)
39. Pyridine	0.017

OR

INCINERATION AS A METHOD OF TREATMENT

2.0 INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

This section describes the industries that may be affected by the land disposal restrictions for K026, the processes generating the waste, and available waste characterization data.

2.1 Industry Affected and Process Description

K026 is defined as stripping still tails from the production of methyl ethyl pyridine (MEP). A search of available data indicates that MEP is no longer produced domestically.

MEP is among the pyridine bases that are produced commercially by synthesis rather than by isolation from coal tar. Figure 2-1 includes a generic process diagram for MEP production. Acetaldehyde and sulfuric acid are reacted to form crude paraldehyde that can be used to produce MEP or sent on for refinement. To produce MEP, the crude paraldehyde is preheated and reacted with ammonia acetate in the presence of an aluminum oxide, aluminum fluoride, or cobalt chloride catalyst. The resulting product stream is then transferred to an ammonia stripping still for ammonia recovery, and then to a decanter. The MEP layer is further refined in a batch still. Residue from the decanter is processed in a water stripping still. The stripping still tails comprise the waste stream of concern.

2.2 Waste Characterization

Available data sources (Reference 3) indicate the following general composition for K026:

Constituent	Concentration (%)
Paraldehyde	50
Pyridines	3
Picolines	3
Sulfuric Acid	6
Acetates	5
Water	33
Total:	100%

The only specific K026 characterization data that the Agency is aware of indicate that pyridine is present in the untreated waste at 32,500 ppm. Concentrations of other BDAT List constituents were not reported.

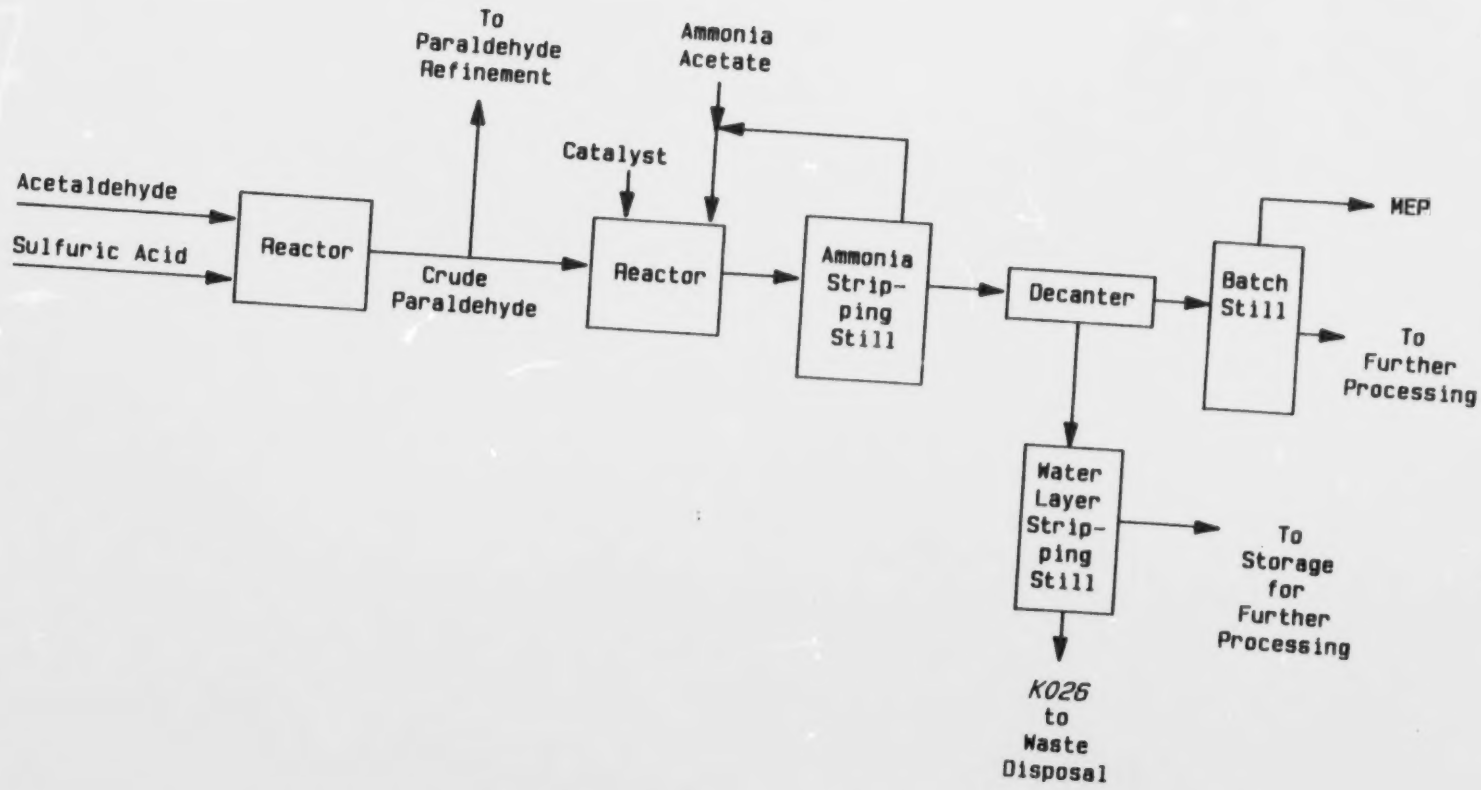


Figure 2-1. Flow Diagram for the Production of Methyl Ethyl Pyridine (MEP)

3.0 APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

This section discusses the technologies that are applicable to treatment of K026 nonwastewaters and wastewaters and determines which, if any, of the applicable technologies can be considered demonstrated for the purpose of establishing BDAT.

To be applicable, a technology must theoretically be usable to treat the waste in question or a waste that is similar in terms of parameters that affect treatment selection. (Detailed descriptions of technologies that are applicable to listed hazardous wastes are provided in EPA's Treatment Technology Background Document (Reference 4.) To be demonstrated, a technology must be employed in full-scale operation for treatment of the waste in question or a similar waste. Technologies available only at pilot- or bench-scale operations are not considered in identifying demonstrated technologies.

3.1 Applicable Treatment Technologies

The following subsections present applicable treatment technologies for nonwastewater and wastewater forms of K026.

Nonwastewaters

Since nonwastewater forms of K026 consist primarily of organic compounds (as shown in Section 2.0 of this document), applicable treatment

technologies include those that destroy or reduce the total amount of various organic compounds in the waste. The Agency has identified the following treatment technologies as potentially applicable for these wastes: (1) incineration (fluidized bed and rotary kiln); (2) solvent extraction followed by incineration or recycle of the extract; and (3) critical fluid extraction followed by recycle or incineration of the contaminated solvents. These treatment technologies were identified based on current waste treatment practices and engineering judgment.

Incineration. Incineration is a destruction technology in which energy, in the form of heat, is transferred to the waste to destabilize chemical bonds and destroy organic constituents. In a fluidized bed incinerator, waste is injected into the fluidized bed material (generally sand and/or incinerator ash), where it is heated to its ignition temperature. Heat energy from the combustion reactions is then transferred back to the fluidized bed. Ash is removed periodically during operation and during bed change-outs.

In a rotary kiln incinerator, wastes are fed into the elevated end of the kiln, and the rotation of the kiln mixes the waste with hot gases to heat the waste to its ignition temperature. Ash is removed from the lower end of the kiln. Combustion gases from the kiln enter the afterburner for complete destruction of organic waste constituents. Other wastes may also be injected into the afterburner.

Combustion gases from the fluidized bed or kiln afterburner are then fed to a scrubber system for cooling and removal of entrained particulates and acid gases, if present. In general, two residuals are generated by incineration processes: ash and scrubber water.

Solvent Extraction. Solvent extraction is a separation technology in which organics are removed from the waste due to greater constituent solubility in the solvent phase than in the waste phase. This technology results in the generation of two treatment residuals: a treated waste residual and an extract. The extract may be recycled or further treated by incineration.

Critical Fluid Extraction. Critical fluid extraction is a solvent extraction technology in which the solvent is brought to its critical state to aid in the extraction of organic constituents from the wastes. After the extraction step, the solvent (liquefied gas at its critical state) is brought to its normal condition in the gaseous state and generates a small volume of extract that is concentrated in organic constituents. This technology results in the generation of two treatment residuals: a treated waste and an extract. The extract may be recycled or further treated by incineration.

Wastewaters

Since wastewater forms of K026 may contain organic constituents at treatable concentrations, applicable technologies include those that destroy

or reduce the total amount of various organic compounds in the waste. The Agency has identified the following treatment technologies as potentially applicable for treatment of K026 wastewaters: (1) incineration; (2) steam stripping; (3) biological treatment; (4) carbon adsorption; and (5) solvent extraction.

Incineration. Incineration of wastewaters in a rotary kiln or fluidized bed is identical to that for nonwastewaters described previously in this section. In addition, liquid injection incineration may also be an applicable technology for treatment of K026 wastewaters.

In a liquid injection incinerator, liquid wastes are atomized and injected into the incinerator. Combustion gases from the incinerator are then fed to a scrubber system for cooling and removal of entrained particulates and acid gases, if present. In general, only wastes with low or negligible ash content are amenable to liquid injection incineration. Therefore, the technology generally does not result in the generation of an ash residual.

Steam Stripping. Steam stripping is a separation technology in which organics are removed from the waste by volatilization through the application of heat. This technology results in the formation of two treatment residuals: a treated waste extract and a treated effluent. The treated waste extract and the treated effluent may require further treatment by incineration, and carbon adsorption or biological treatment, respectively.

Biological Treatment. Biological treatment is a destruction technology in which organic constituents in wastewaters are biodegraded. This technology results in the formation of two treatment residuals: a treated effluent and a waste biosludge. The treated effluent and the waste biosludge may require further treatment for metals by chemical precipitation and stabilization, respectively.

Carbon Adsorption. Carbon adsorption is a separation technology in which organic constituents in wastewaters are selectively adsorbed onto activated carbon. This technology results in the formation of two treatment residuals: a treated effluent and spent activated carbon. The treated effluent may require further treatment for metals by chemical precipitation. The spent carbon may require further treatment by incineration.

Solvent Extraction. Solvent extraction of wastewaters is identical to that for nonwastewaters described previously in this subsection.

3.2 Demonstrated Treatment Technologies

The Agency is not aware of any facilities that treat K026 nonwastewaters and/or wastewaters. However, rotary kiln incineration is demonstrated for similar wastes, as discussed in Section 4.0 of this document.

The Agency is not aware of any other technologies that are demonstrated for treatment of K026.

4.0 TREATMENT PERFORMANCE DATA BASE

This section presents the treatment performance data that were used to develop proposed treatment standards for nonwastewater and wastewater forms of K026.

Where data are not available on the treatment of the specific waste of concern, the Agency may elect to transfer performance data from a demonstrated treatment technology that treats a similar waste or wastes. EPA's methodology for the transfer of treatment performance data is provided in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1). Transfer of treatment performance data is technically valid in cases where the untested wastes are generated from similar industries or similar processing steps, or have similar waste characteristics affecting treatment selection and performance that are similar to those of the tested wastes.

The Agency does not have any treatment performance data for treatment of K026 nonwastewaters or wastewaters. However, treatment performance data were available from other wastes previously tested by EPA and were transferred to develop proposed treatment standards for K026. Sources of treatment performance data for potential transfer to K026 include wastes previously tested by incineration (including rotary kiln and fluidized bed incineration). Incineration was identified as applicable and demonstrated for treatment of these wastes, as discussed in Section 3.0 of this document.

Previous incineration tests conducted by the Agency are listed in Table 4-1 at the end of this section. EPA examined the wastes incinerated in these tests to identify the best data source(s), if any, for transfer of treatment performance data to K026 nonwastewaters and wastewaters. Specifically, EPA examined (1) whether the untested K026 is generated from a similar industry or processing step and (2) whether the waste has similar waste characteristics as those previously tested wastes.

Wastes included in Tests 3, 4, 5, 11, 12, 13, and 14 are generated by the organic chemicals industry. Like K026, wastes incinerated in Tests 3, 4, 5, 11, and 14 were generated by distillation or some other type of separation process.

Of the wastes generated by a process similar to that generating K026, those incinerated in Tests 3, 4, and 14 contain nitrogenated compounds and are, therefore, most structurally similar to K026. The wastes incinerated in these tests are also similar to K026 in that they are all organic wastes. The constituents in the RCRA Blend waste incinerated in Test 4 are more similar to K026 than those in Tests 3 and 14 with respect to structure and physical properties that affect the treatment performance of incineration, such as boiling points and bond dissociation energies. In addition, the RCRA Blend waste incinerated in Test 4 is expected to have a similar thermal conductivity to K026. Therefore, treatment performance similar to that achieved for the RCRA Blend waste could be achieved for K026.

Based on the similarities discussed above, a treatment standard for the constituent being proposed for regulation in K026 nonwastewaters and wastewaters was developed based on treatment performance data transferred from rotary kiln incineration of the RCRA Blend waste that was co-incinerated with K019 in Test 4 (Reference 5).

K019 and three other wastes, referred to as "RCRA Blend", "PCB Blend", and "mercaptan-contaminated waste", were treated in Test 4. K019, RCRA Blend waste, PCB Blend waste, and mercaptan-contaminated waste comprised approximately 20%, 23%, 41%, and 16%, respectively, of the waste treated. K019 and RCRA Blend were fed to the rotary kiln; PCB Blend and mercaptan-contaminated waste were fed to the afterburner (secondary combustor). The ash generated from rotary kiln incineration results from treatment of the K019 and RCRA Blend wastes only, while scrubber water results from treatment of all four wastes fed to the incinerator. The ash data from the incineration of K019 and RCRA Blend waste were transferred to K026 nonwastewaters, and the scrubber water data from incineration of all four wastes were transferred to K026 wastewaters. Tables 4-2 and 4-3 present the BDAT List constituents detected in the untreated wastes and in the kiln ash residual for six sample sets collected by EPA from the rotary kiln incineration treatment system. Table 4-4 presents BDAT List constituents detected in the scrubber water residual for six sample sets collected by EPA from the same incineration system. Design and operating data are presented in Table 4-5 for each sample set. All tables are presented at the end of this section.

Table 4-1

WASTES TESTED BY INCINERATION AND SAMPLED BY EPA

Test Number	Waste Code(s)	Treatment Technology Used
1	K001 - Pentachlorophenol waste	Rotary kiln incineration
2	K001 - Creosote waste	Rotary kiln incineration
3	K011, K013, K014	Rotary kiln incineration
4	K019	Rotary kiln incineration
5	K024	Rotary kiln incineration
6	K037	Rotary kiln incineration
7	K048, K051	Fluidized bed incineration
8	K087	Rotary kiln incineration
9	K101	Rotary kiln incineration
10	K102	Rotary kiln incineration
11	F024	Rotary kiln incineration
12	K015	Liquid injection incineration
13	D014, D016, P059*, U127*, and U192*	Rotary kiln incineration
14	U141*, U028*, P020*, U112*, U226*, U239*, U080*, U220*, U166*, U161*, and U188*	Rotary kiln incineration

*Commercial chemical products were used in these test burns as surrogates for these wastes.

Table 4-2

WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

BDAT List Constituent		Wastes fed to the Rotary Kiln[a]		Wastes fed to the Secondary Combustor	
		K019 (ppm)	RCRA Blend (ppm)	PCB Blend (ppm)	Mercaptan-Contaminated Waste (ppm)
VOLATILES					
4.	Benzene	<2,000	2,000	<2,000	17.0
7.	Carbon tetrachloride	3,500-4,100	<8	<2,000	1.9
9.	Chlorobenzene	<2,000-3,000	<8	<2,000	<0.4
14.	Chloroform	4,600-6,000	<8	<2,000	<0.4
22.	1,1-Dichloroethane	<2,000-2,200	<8	<2,000	<0.4
23.	1,2-Dichloroethane	87,000-130,000	<8	<2,000	<0.4
34.	Methyl ethyl ketone	<10,000	940	<10,000	3.5
38.	Methylene chloride	<10,000	910	<10,000	<2.0
42.	Tetrachloroethene	6,000-7,800	490	<10,000	<0.4
43.	Toluene	<2,000	2,300	<2,000	3.7
45.	1,1,1-Trichloroethane	33,000-81,000	130	<2,000	2.3
47.	Trichloroethene	2,200-3,210	360	3,600	<0.4
215-217.	Xylene (total)	<2,000	3,400	36,000	4.4
222.	Acetone	<10,000	1,200	<10,000	<2.0
226.	Ethyl benzene	<2,000	2,200	16,000	4.1
229.	Methyl isobutyl ketone	<10,000	1,100	<10,000	<2.0

[a] Six sample sets of K019 were collected; results are presented as ranges, where appropriate. Only one sample of RCRA Blend, PCB Blend, and Mercaptan-Contaminated wastes were collected.

Note: This table shows the concentrations in the untreated waste for all constituents that were detected in the untreated waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 6).

Table 4-2 (Continued)

WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

BDAT List Constituent		Wastes fed to the Rotary Kiln[a]		Wastes fed to the Secondary Combustor	
		K019 (ppm)	RCRA Blend (ppm)	PCB Blend (ppm)	Mercaptan-Contaminated Waste (ppm)
SEMIVOLATILES					
51.	Acenaphthalene	<10	150	120	<0.002
52.	Acenaphthene	<10	<20	480	<0.002
56.	Aniline	<25	<50	<250	1.220
57.	Anthracene	<10	110	400	<0.002
65.	Benzo(k)fluoranthene	<10	67	<100	<0.002
68.	Bis(2-chloroethyl)ether	280-340	<20	<100	<0.002
70.	Bis(2-ethylhexyl)phthalate	<10	40	<100	0.079
80.	Chrysene	SNA	28	<100	<0.002
81.	ortho-Cresol	<10	<20	<100	0.020
87.	o-Dichlorobenzene	<10	250	1,060	2.550
88.	p-Dichlorobenzene	74-90	32	460	0.260
90.	2,4-Dichlorophenol	<25	<50	<250	0.420
91.	2,6-Dichlorophenol	<25	<50	500	0.430

[a] Six sample sets of K019 were collected; results are presented as ranges, where appropriate. One sample of RCRA Blend, PCB Blend, and Mercaptan-Contaminated wastes were collected.

Note: This table shows the concentrations in the untreated waste for all constituents that were detected in the untreated waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 6).

Table 4-2 (Continued)

WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

BDAT List Constituent		Wastes fed to the Rotary Kiln[a]		Wastes fed to the Secondary Combustor	
		K019 (ppm)	RCRA Blend (ppm)	PCB Blend (ppm)	Mercaptan-Contaminated Waste (ppm)
SEMIVOLATILES (Cont.)					
98.	Di-n-butyl phthalate	<10	31	120	0.012
104.	Di-n-octyl phthalate	<10	<20	430	<0.002
108.	Fluoranthene	<10	120	300	<0.002
109.	Fluorene	16-22	53	340	<0.002
110.	Hexachlorobenzene	60-87	<100	<500	0.022
111.	Hexachlorobutadiene	<50	210	<500	0.079
113.	Hexachloroethane	85-120	<100	<500	0.018
121.	Naphthalene	314-470	<20	400	0.133
122.	1,4-Naphthoquinone	<10	<20	<100	0.078
126.	Nitrobenzene	<25	3,400	8,200	0.027
136.	Pentachlorobenzene	51-65	<100	1,000	0.020
141.	Phenanthrene	11-21	240	950	<0.002
142.	Phenol	<10	78	1,000	4.56
145.	Pyrene	<10	200	260	<0.002
148.	1,2,4,5-Tetrachlorobenzene	62-86	<50	1,400	0.008
150.	1,2,4-Trichlorobenzene	65-100	<50	9,000	1.24
152.	2,4,6-Trichlorophenol	<50	<100	<500	0.037

[a] Six sample sets of K019 were collected; results are presented as ranges, where appropriate. One sample of RCRA Blend, PCB Blend, and Mercaptan-Contaminated wastes were collected.

Note: This table shows the concentrations in the untreated waste for all constituents that were detected in the untreated waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 6).

Table 4-2 (Continued)

WASTE CHARACTERIZATION DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

BDAT List Constituent	Wastes fed to the Rotary Kiln[a]		Wastes fed to the Secondary Combustor	
	K019 (ppm)	RCRA Blend (ppm)	PCB Blend (ppm)	Mercaptan-Contaminated Waste (ppm)
METALS				
155. Arsenic	<0.2-1.2	94	7.4	<0.02
156. Barium	<0.9-0.97	1.3	<19	1.67
158. Cadmium	<0.3-0.63	<0.3	<33	<0.003
159. Chromium	1.8-5.3	40	23.7	<0.009
160. Copper	<1.0-3.6	165	107	0.027
161. Lead	2.1-3.5	27	<7.3	0.0064
163. Nickel	2.2-6.0	8.8	6.2	0.037
168. Zinc	4.4-9.4	4,170	6810	0.071
INORGANICS				
171. Sulfide	790	830	16,000	17

[a] Six sample sets of K019 were collected; results are presented as ranges, where appropriate. One sample of RCRA Blend, PCB Blend, and Mercaptan-Contaminated wastes were collected.

Note: This table shows the concentrations in the untreated waste for all constituents that were detected in the untreated waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 6).

Table 4-3

TREATMENT PERFORMANCE DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

KILN ASH RESIDUAL

BDAT List Constituent	DETECTION LIMIT	SAMPLE SET #1	SAMPLE SET #2	SAMPLE SET #3	SAMPLE SET #4	SAMPLE SET #5	SAMPLE SET #6
		Concentration in Kiln Ash - Total Concentration (mg/kg)					
SEMIVOLATILES							
70. Bis(2-ethylhexyl)phthalate	2	ND	ND	ND	12	ND	ND
72. Di-n-butyl phthalate	2	ND	ND	ND	230	ND	ND
METALS							
154. Antimony	6.0	8.0	6.8	9.2	ND	9.1	9.6
155. Arsenic	0.2	3.6	2.8	5.7	5.7	3.9	2.3
156. Barium	0.9	26	23	54	8.4	21	11
158. Cadmium	0.3	0.66	0.96	3.6	ND	1.2	2.2
159. Chromium	0.9	44	60	202	28	125	141
160. Copper	1.0	2370	3430	2290	1270	2780	2520
161. Lead	0.2	120	42	118	25	86	34
163. Nickel	2.0	66	89	169	69	166	288
165. Silver	0.9	3.3	3.4	1.9	2.6	3.3	3.1
167. Vanadium	2.0	4.1	4.8	6.0	ND	5.7	8.7
168. Zinc	0.6	12	13	16	11	22	13
INORGANICS							
170. Fluoride	2	38	ND	6.1	3.2	23	4.7
171. Sulfide	50	68	5.1	64	ND	64	92

ND - The compound was not quantified at or above the detection limit.

Note: This table shows the concentrations in the kiln ash for all constituents that were detected in the nonwastewater residuals generated from treatment of the waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 6).

Table 4-4

TREATMENT PERFORMANCE DATA COLLECTED BY EPA FOR K019
AND OTHER WASTES TREATED BY ROTARY KILN INCINERATION

SCRUBBER WATER RESIDUAL

BDAT List Constituent	DETECTION LIMIT	SAMPLE SET #1	SAMPLE SET #2	SAMPLE SET #3	SAMPLE SET #4	SAMPLE SET #5	SAMPLE SET #6
	Concentration in Scrubber Water - Total Concentration (ug/l)						
VOLATILES							
21. Dichlorodifluoromethane	2	ND	ND	4.3	14	ND	ND
43. Toluene	2	ND	3.2	2.6	4.6	ND	ND
SEMIVOLATILES							
98. Di-n-butyl phthalate	2	ND	6.3	4.6	4.2	2.7	2.5
METALS							
154. Antimony	240	410	390	410	400	350	320
155. Arsenic	2	46	38	30	29	27	33
156. Barium	9	480	500	530	550	600	570
157. Beryllium	1	ND	ND	ND	ND	2	ND
158. Cadmium	3	230	190	150	130	120	110
159. Chromium	9	110	140	130	140	140	130
160. Copper	10	1810	1380	1180	1130	1030	870
161. Lead	80	820	780	640	600	480	400
162. Mercury	0.2	2	2.6	1.5	0.4	1	1
163. Nickel	20	81	68	57	65	67	61
165. Silver	9	85	95	92	92	90	92
167. Vanadium	20	160	180	150	150	160	160
168. Zinc	6	11,400	11,000	9500	9980	11,100	10,400
INORGANICS							
170. Fluoride	10	20,000	15,000	14,000	13,000	12,000	12,000

ND - The compound was not quantified at or above the detection limit.

Note: This table shows the concentrations in the scrubber water for all constituents that were detected in the wastewater residuals generated from treatment of the waste.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 6).

Table 4-5

DESIGN AND OPERATING DATA FOR THE ROTARY KILN AND SECONDARY COMBUSTOR

Parameter (units)	Design Value	SAMPLE SET #1	SAMPLE SET #2	SAMPLE SET #3	SAMPLE SET #4	SAMPLE SET #5	SAMPLE SET #6
Kiln Outlet Temperature (^{o}F)	o	1825-1900	1800-1880	1850-1900	1775-1900	1775-1800	1775-1850
Kiln Solids Residence Time (min)	o	120	120	120	120	120	120
Kiln Waste Feed Rate (MMBTU/hr)	o						
K019:		13.1	12.2	12.4	12.7	11.7	11.5
RCRA Blend, Burner #1:		3.9-5.5	5.2-5.5	5.2-5.8	5.2-5.8	5.2-6.0	5.2-5.8
RCRA Blend, Burner #2:		4.4-9.7	4.4-9.7	4.4-8.4	4.4-7.3	5.2-9.7	5.2-9.7
	Total:	21.4-28.3	21.8-27.4	22.0-26.6	22.3-25.8	22.1-27.4	21.9-27
Kiln Rotational Speed (RPM)	o	0.19-0.21	0.19-0.21	0.19-0.21	0.19-0.21	0.19-0.21	0.19-0.21
Afterburner Temperature (^{o}F)	o	2380	2400	2400	2400	2400	2350
Afterburner Residence Time (sec)	o	2	2	2	2	2	2
Afterburner Waste Feed Rate (MMBTU/hr)	o						
PCB Blend:		36.1	36.5	36.5	36.5	37.5	37.5
Mercaptan-Contaminated Waste:		0.18	0.18	0.18	0.18	0.18	0.18
	Total:	36.28	36.68	36.68	36.68	37.68	37.68
Stack Oxygen Concentration (%)	NA	6.8	7.0	7.2	6.4	6.8	7.0
Stack Carbon Monoxide Concentration (ppm volume)	NA	NR	NR	0	0	NR	NR

o - This information has been claimed RCRA Confidential Business Information. The information is available in the confidential portion of the Administrative Record for the First Thirds Rulemaking of August 17, 1988.

Source: BDAT Background Document for K016, K018, K019, K020, K030 (Reference 6).

NA - Not applicable.
NR - Not recorded.

5.0 IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section discusses technologies that are available for treatment of K026 nonwastewaters and wastewaters and identifies proposed BDAT for K026 nonwastewaters and wastewaters.

For a treatment technology to be identified as BDAT, the treatment performance data are first screened to determine whether they represent a well-designed and well-operated treatment system, whether sufficient analytical quality assurance/quality control measures were employed to ensure the accuracy of the data, and whether the appropriate measures of performance were used to assess the performance of the particular treatment technology.

The treatment performance data and the design and operating data collected during the RCRA Blend waste treatment test (Test 4) were reviewed for the points described above. The appropriate measure of performance (total constituent concentration) was used to assess the treatment system. Additionally, the Agency had no reason to believe that this treatment system was not well-designed and well-operated, or that insufficient analytical quality assurance/quality control measures were employed in generating treatment performance data.

An available treatment technology is one that (1) is not a proprietary or patented process that cannot be purchased or licensed from the proprietor (i.e., it must be commercially available), and (2) substantially

diminishes the toxicity of the waste or substantially reduces the likelihood of migration of hazardous constituents from the waste. The technology that is demonstrated for treatment of K026, incineration, is considered to be commercially available and to provide substantial treatment of the waste. Therefore, incineration is "available" for treatment of K026.

In summary, incineration has been determined to be demonstrated and available for treatment of nonwastewater and wastewater forms of K026. However, because the Agency does not have treatment performance data for any other demonstrated and available technologies treating K026 or similar wastes, this treatment technology is considered to be the best. Therefore, the best demonstrated available technology (BDAT) for K026 has been determined to be incineration.

6.0 SELECTION OF CONSTITUENTS PROPOSED FOR REGULATION

The Agency has developed a list of hazardous constituents (the BDAT Constituent List, presented in EPA's Methodology for Developing BDAT Treatment Standards (Reference 1)) from which constituents to be regulated are selected for regulation. EPA may revise this list as additional data and information become available. The list is divided into the following categories: volatile organics, semivolatile organics, metals, inorganics other than metals, organochlorine pesticides, phenoxyacetic acid herbicides, organophosphorus insecticides, PCBs, and dioxins and furans. This section presents the rationale for the selection of pyridine for proposed regulation in wastewater and nonwastewater forms of K026.

Generally, constituents selected for proposed regulation must satisfy the following criteria:

(1) The constituent must be on the BDAT List of regulated constituents. Presence on the BDAT List means that approved methods to analyze for the constituent in treated waste matrices exist.

(2) The constituent must be present in, or be suspected of being present in, the untreated waste. For example, in some cases, analytical difficulties (such as masking) may prevent a constituent from being identified in the untreated waste, but its identification in a treatment residual may lead the Agency to conclude that it is present in the untreated waste.

The Agency reviewed all available K026 characterization data for these criteria. (These data are presented in Table 2-1 of this document.) Pyridine was the only BDAT List constituent for which analytical results were quantified above the detection limit and reported. Accordingly, pyridine was

the only BDAT List constituent selected for proposed regulation in nonwastewater and wastewater forms of K026.

7.0 CALCULATION OF PROPOSED BDAT TREATMENT STANDARDS

The Agency bases numerical treatment standards for regulated constituents on the performance of well-designed and well-operated BDAT treatment systems. These standards must account for analytical limitations in available treatment performance data, and the data must be adjusted for variabilities related to treatment, sampling, and analytical techniques and procedures. The purpose of this section is to calculate proposed treatment standards for K026 nonwastewaters and wastewaters for the constituent selected for proposed regulation using the available treatment performance data from the treatment technology identified as BDAT.

Proposed BDAT treatment standards for K026 nonwastewaters and wastewaters are based on the demonstrated technology of incineration.

Before treatment standards are calculated, the treatment performance data are corrected to account for analytical interferences associated with the chemical matrices of the samples. A complete discussion of the accuracy correction of treatment data is provided in Appendix A. Appendix A also contains the matrix spike recoveries and accuracy correction factors used to correct the treatment performance data, as well as the corrected treatment performance data.

After treatment performance data are corrected for accuracy, the arithmetic average of the corrected data is calculated for each regulated

constituent. In cases where the constituent is not detected in the treatment residual at or above its detection limit, the detection limit is used to calculate the average constituent concentration in the treated waste. Tables 7-1 and 7-2 at the end of this section present the averages of the corrected treatment performance data for the constituent proposed for regulation in K026 nonwastewaters and wastewaters, respectively.

The next step in calculating treatment standards is to determine the variability factor (VF) for each regulated constituent. The variability factor accounts for the variability inherent in treatment system performance, treatment residual collection, and treatment sample analysis. (For more information on calculation of variability factors, see EPA's Methodology for Developing BDAT Treatment Standards (Reference 1).) Variability factors for the constituent proposed for regulation in K026 are shown in Tables 7-1 and 7-2.

Finally, the treatment standard is calculated for each constituent proposed for regulation by multiplying the average of the correct treatment performance values by the variability factor for the constituent. Proposed treatment standards for nonwastewater and wastewater forms of K026 are presented in Tables 7-1 and 7-2 and are discussed in greater detail in the following sections.

7.1 Calculation of the Proposed Treatment Standard for K026 Nonwastewaters

Treatment performance data for the ash from rotary kiln incineration of K026 are not available. Therefore, the Agency is transferring performance data from treatment of organic constituents in RCRA Blend waste to develop treatment standards for organic constituents in nonwastewater forms of K026. The rationale for this transfer is presented in Section 4.0 of this document.

Incineration generally results in the generation of ash (a nonwastewater) and combustion gas scrubber water (a wastewater). The best measure of performance for a destruction technology, such as incineration, is the total amount of each constituent of concern remaining after treatment. Therefore, the proposed BDAT treatment standard for pyridine in K026 nonwastewaters was calculated based on total constituent concentration data transferred from the ash residual from incineration of RCRA Blend waste (Reference 7).

The proposed treatment standard for pyridine in K026 nonwastewaters was calculated using six sample sets of data for rotary kiln incineration of RCRA Blend waste (Reference 7). Tables 4-2 and 4-3 of this document present the total concentrations of each organic constituent detected in untreated RCRA Blend waste and the treated nonwastewater residual (ash). Because pyridine was not detected in the untreated RCRA Blend waste, treatment performance data for pyridine in K026 nonwastewaters were transferred from nitrobenzene in RCRA Blend waste, as explained below.

The particular constituent from which data are transferred is determined based on the characteristics of the waste that affect treatment performance by incineration with respect to the nonwastewater residual (i.e., incinerator ash) and the structural similarities between the constituents from and to which data are transferred. In the rotary kiln, energy in the form of heat is transferred to the waste to volatilize the organic waste constituents. To determine whether one constituent is volatilized similarly to another constituent, the Agency examines the boiling points and the structural similarities of the constituents.

In general, the Agency believes that a constituent with a higher boiling point (bp) is more difficult to treat than a constituent with a lower boiling point. Whenever possible, treatment performance data are transferred from constituents detected in the untreated waste that have equal or higher boiling points. For K026 nonwastewaters, treatment performance data were transferred from nitrobenzene to pyridine, since nitrobenzene was detected in the untreated waste and has a higher boiling point than pyridine.

The calculation calculation of the proposed treatment standard for pyridine in K026 nonwastewaters is shown in Table 7-1.

7.2 Calculation of the Proposed Treatment Standard for K026 Wastewaters

Treatment performance data for the scrubber water from rotary kiln incineration of K026 are not available. Therefore, the Agency is transferring performance data from treatment of organic constituents in RCRA Blend waste to

develop treatment standards for organic constituents in wastewater forms of K026. The rationale for this transfer is presented in Section 4.0 of this document.

Incineration generally results in the generation of ash (a nonwastewater) and combustion gas scrubber water (a wastewater). The best measure of performance for a destruction technology, such as incineration, is the total amount of each constituent of concern remaining after treatment. Therefore, the proposed BDAT treatment standard for pyridine in K026 wastewaters was calculated based on total constituent concentration data transferred from the scrubber water residual from incineration of RCRA Blend waste (Reference 7).

The proposed treatment standard for pyridine in K026 wastewaters was calculated using six sample sets of data from rotary kiln incineration of RCRA Blend waste. Tables 4-2 and 4-4 of this document present the total concentrations of each organic constituent detected in the untreated RCRA Blend waste and the treated wastewater residual (scrubber water). Because pyridine was not detected in the untreated RCRA Blend waste, treatment performance data for pyridine in K026 wastewaters were transferred from nitrobenzene in RCRA Blend waste, as explained below.

The particular constituent from which data are transferred is determined based on the characteristics of the waste that affect treatment performance of incineration with respect to the wastewater residual (i.e., scrubber water) and the structural similarities between the constituents from and to which data are transferred. In the secondary chamber (or afterburner),

energy in the form of heat is added to destabilize chemical bonds to initiate the combustion reactions. To determine whether one constituent is destabilized similarly to another constituent, the Agency examines the bond dissociation energies and the structural similarities of the constituents.

In general, the Agency believes that a constituent with a higher bond dissociation energy (BDE) is more difficult to treat than a constituent with a lower BDE. Whenever possible, treatment performance data are transferred from constituents detected in the untreated waste that have equal or higher BDEs. For K026 wastewaters, treatment performance data were transferred from nitrobenzene to pyridine, since nitrobenzene was detected in the untreated waste and has a higher bond dissociation energy than pyridine.

The calculation of the proposed treatment standard for pyridine in K026 wastewaters is shown in Table 7-2.

Table 7-1

CALCULATION OF TREATMENT STANDARDS FOR CONSTITUENTS PROPOSED FOR REGULATION IN K026

NONWASTEWATERS

BDAT List Constituent Proposed for Regulation	Constituent from Which Treatment Performance Data in RCRA Blend Waste Were Transferred	Arithmetic Average of Corrected Treatment Performance Values (ppm)	Variability Factor (VF)	Treatment Standard (Average x VF) (ppm)
39. Pyridine	Nitrobenzene	5.0	2.8	14

WASTEWATERS

BDAT List Constituent Proposed for Regulation	Constituent from Which Treatment Performance Data in RCRA Blend Waste Were Transferred	Arithmetic Average of Corrected Treatment Performance Values (ppm)	Variability Factor (VF)	Treatment Standard (Average x VF) (ppm)
39. Pyridine	Nitrobenzene	0.006	2.8	0.017

8.0 ACKNOWLEDGEMENTS

This document was prepared for the U.S. Environmental Protection Agency, Office of Solid Waste, by Radian Corporation, under Contract No. 68-W9-0072. This document was prepared under the direction of Mr. James Berlow, Chief, Waste Treatment Branch; Mr. Larry Rosengrant, Acting Section Head, Treatment Technology Section; and Mr. Jerry Vorbach, Project Officer. Mr. Jose Labiosa served as the project manager for K026 regulatory development. Mr. Steve Silverman served as EPA legal advisor.

The following personnel from Radian Corporation were involved in preparing this document: Mr. John Williams, Program Manager; Ms. Lori Stoll, Project Director; and the Radian engineering team, Ms. Debra Falatko, Ms. Chrisanti Haretos, and Ms. Colleen Kane.

9.0 REFERENCES

1. USEPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Methodology for Developing BDAT Treatment Standards. June, 1989. Washington, DC.: U.S. Environmental Protection Agency.

2. American Public Health Association, American Water Works Association, and the Water Pollution Control Federation. 1985. Standard Methods for the Examination of Water and Wastewaster, Sixteenth Edition. Washington, DC.: American Public Health Association.

3. USEPA. 1985. U.S. Environmental Protection Agency, Office of Solid Waste. Characterization of Waste Streams Listed in 40 CFR Section 261 Waste Profiles. Two volumes. Washington, DC.: U.S. Environmental Protection Agency.

4. USEPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Treatment Technology Background Document. June, 1989. Washington, DC.: U.S. Environmental Protection Agency.

5. USEPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Non-confidential version of the Onsite Engineering Report of Treatment Technology Performance and Operation for Rollins Environmental Services (TX) Inc., Deer Park, TX. March 11, 1988. Washington, D.C.: U.S. Environmental Protection Agency.

6. USEPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for K016, K018, K019, K020, K030. August, 1988. Washington, DC.: U.S. Environmental Protection Agency.

7. USEPA. 1981. U.S. Environmental Protection Agency, Office of Solid Waste. Identification and Listing of Hazardous Wastes under RCRA, Subtitle C, Section 3001. Washington, D.C.: U.S. Environmental Protection Agency.

Appendix A

ACCURACY CORRECTION OF TREATMENT PERFORMANCE DATA

Appendix A

ACCURACY CORRECTION OF TREATMENT PERFORMANCE DATA

The treatment performance data used to determine treatment standards for K026 were adjusted to account for analytical interferences associated with the chemical matrices of the samples. Generally, treatment performance data were corrected for accuracy as follows: (1) a matrix spike recovery was determined for each BDAT List constituent detected in the untreated or treated waste; (2) an accuracy correction factor was determined for each of the above constituents by dividing 100 by the matrix spike recovery (percent) for that constituent; and (3) treatment performance data for each BDAT List constituent detected in the untreated or treated waste were corrected by multiplying the reported concentration of each constituent by its corresponding accuracy correction factor. The procedure for accuracy correction of the data is described in further detail below.

Matrix spike recoveries are developed by analyzing a sample of a treated waste for a constituent and then re-analyzing the sample after the addition of a known amount of the same constituent (i.e., spike) to the sample. The matrix spike recovery represents the total amount of constituent recovered after spiking, minus the initial concentration of the constituent in the sample, and the result divided by the spike concentration of the constituent.

Matrix spike recoveries used to adjust the treatment performance data transferred to K026 are shown in Tables A-1 and A-2. Duplicate matrix spikes were performed for some BDAT List constituents. If a duplicate matrix spike was performed for a constituent, the matrix spike recovery used for that constituent was the lower of the two values from the first matrix spike and the duplicate spike. An accuracy correction factor of 1 was used when matrix spike and duplicate matrix spike recoveries both exceeded 100%, so that the data were not adjusted to concentrations below the detection limits.

Where a matrix spike was not performed for an organic constituent (as is the case with nitrobenzene in RCRA Blend waste), the matrix spike recovery for that constituent was derived from the average matrix spike recoveries of the appropriate group of constituents (e.g., semivolatile organics) for which recovery data were available. In this case, the matrix spike recoveries for all semivolatiles from the first matrix spike were averaged. Similarly, an average matrix spike recovery was calculated for the duplicate matrix spike recoveries. The lower of the two average matrix spike recoveries of the semivolatile organics group was used for any semivolatile constituents of interest for which no matrix spike was performed, in this case, nitrobenzene. The lower average recovery for kiln ash residuals was 100%, and that for scrubber water residuals was 84%.

The accuracy correction factors used to calculate the proposed K026 treatment standards are 1.00 for nonwastewater and 1.19 for wastewater. The

corrected treatment concentrations for nitrobenzene in RCRA Blend waste nonwastewaters and wastewaters are presented in Table A-3.

Table A-1

MATRIX SPIKE RECOVERIES FOR KILN ASH RESIDUAL

Spike Constituent	Original Amount Found (ppm)	Sample Result			Duplicate Sample Result		
		Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[a] (%)	Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[a] (%)
SEMIVOLATILE ORGANICS (ACID EXTRACTABLES)							
76. p-Chloro-m-cresol	<5	100	110	110	100	120	120
78. 2-Chlorophenol	<2	100	98	98	100	100	100
127. 4-Nitrophenol	<10	100	97	97	100	110	110
139. Pentachlorophenol	<50	100	88	88	100	88	88
142. Phenol	<2	100	90	90	100	97	97
SEMIVOLATILE ORGANICS (BASE/NEUTRAL FRACTION)							
52. Acenaphthene	<2	50	55	110	50	55	110
88. 1,4-Dichlorobenzene	<2	50	45	90	50	49.5	99
102. 2,4-Dinitrotoluene	<50	50	53.5	107	50	55	110
105. N-Nitroso-di-n-propylamine	<5	50	60	120	50	65	130
145. Pyrene	<2	50	60	120	50	46	92
150. 1,2,4-Trichlorobenzene	<5	50	37.5	75	50	40	80

[a]Percent recovery = 100 x $(C_i-C_o)/C_t$, where C_i = amount recovered, C_o = original amount found, and C_t = amount spiked.

Source: Non-confidential version of the Onsite Engineering Report of Treatment Technology Performance and Operation for Rollins Environmental Services (TX) Inc., Deer Park, TX (Reference 5).

Table A-2

MATRIX SPIKE RECOVERIES FOR SCRUBBER WATER RESIDUAL

Spike Constituent	Original Amount Found (ppm)	Sample Result			Duplicate Sample Result		
		Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[a] (%)	Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[a] (%)
SEMIVOLATILE ORGANICS (ACID EXTRACTABLES)							
76. p-Chloro-m-cresol	<2	100	87	87	100	85	85
78. 2-Chlorophenol	<50	100	81	81	100	78	78
127. 4-Nitrophenol	<50	100	62	62	100	43	43
139. Pentachlorophenol	<2	100	58	58	100	45	45
142. Phenol	<2	100	74	74	100	70	70
SEMIVOLATILE ORGANICS (BASE/NEUTRAL FRACTION)							
52. Acenaphthene	<5	50	51	102	50	51	102
88. 1,4-Dichlorobenzene	<2	50	34	68	50	35	70
102. 2,4-Dinitrotoluene	<2	50	43	86	50	42	84
105. N-Nitroso-di-n-propylamine	<5	50	50	100	50	46	92
145. Pyrene	<2	50	43	86	50	43	86
150. 1,2,4-Trichlorobenzene	<10	50	30	60	50	34	68

[a]Percent recovery = 100 x $(C_i - C_o)/C_t$, where C_i = amount recovered, C_o = original amount found, and C_t = amount spiked.

Source: Non-confidential version of the Onsite Engineering Report of Treatment Technology Performance and Operation for Rollins Environmental Services (TX) Inc., Deer Park, TX (Reference 5).

Table A-3

ACCURACY-CORRECTED DATA USED TO CALCULATE TREATMENT STANDARDS FOR CONSTITUENTS PROPOSED FOR REGULATION IN K026

BDAT List Constituent	Corrected Total Concentration[a] in RCRA Blend Waste Treatment Residual (ppm)					
Sample Set:	1	2	3	4	5	6
NONWASTEWATERS						
126. Nitrobenzene	5.00	5.00	5.00	5.00	5.00	5.00
WASTEWATERS						
126. Nitrobenzene	0.006	0.006	0.006	0.006	0.006	0.006

[a]Constituent concentrations have been corrected by multiplying the concentration by the accuracy correction factor (ACF) for each constituent.